A Study of Some Biological Aspects of Pacu Piaractus Brachypomus (G. Cuvier, 1818)

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Abstract

The present study attempts to shed light on some biological aspects and characteristics of Piaractus brachypomus, including some biometrics, phenotypic and feeding pattern that characterizes this species. Besides, the study touches upon the body shape and the Otolith. These fish species have recently been seen frozen in the Iraqi local market. The standard length of fish specimens in this study reach 26.55cm it exceeded the specimens of Pacu fish collected from other studies from other countries, As well the specimens weight was 632gm it exceeded other studies mentioned in this manuscript. As the irregularity in the distribution of teeth rows, especially in the lower jaw was clear in our specimens. The average weight of some skull bones of Piaractus brachypomus specimens is 2.25g, which gives evidence of the heaviness of the bones of this species.

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Introduction

Pacu fish is classified within the Serrasalmidae family, which is a class Actinopterygii characidae was a former family that belongs to the Characiformes order. This family includes several genra and species, including Serrasalmus, piranha or piranhas. The diagnosis and classification of Pacu are difficult, complicated, and often controversial. Ichthyologists describe fish according to the traits that may overlap randomly; sometimes, DNA investigation may cause confusion in the diagnosis and classification processes of complex and multi-characteristic fish. The classifications may be inaccurate and random (Magallanes, 2006).

Pacu fish are Amazon River fish, in South America, in the Ornico River basin specifically (Jégu, 2003). Its records were made internationally for the first time in Argentina in 1987 (Lopez et al, 1987), in Slovakia in 2004 (Hensel, 2004), and Iran in Lake Zarivar in western Iran (Zarei and Rajabi, 2017) and considered as an invasive species of the Iranian aquatic environment (Hamid et al., 2017). India classified it as alien to the Indian aquatic environment, especially the Red belly Pacu in 2014 (Roshni and Kurup, 2014). It was recorded as an invasive fish in Polish waters in 2017 (Wiecaszek et al, 2017). It was recorded for the first time in Croatia in 2010 (Čaleta et al, 2011). In Bangladesh in 2011, it was considered an invasive fish for the inland aquatic environment, which could be reared and developed for local consumption as a supplement to the national food basket (Barua and Chakraborty, 2011).

Pacu juveniles feed on some species of insects and plants decomposed in water (Lovshin, 1995). The total protein in the adult fish stomachs is about 69.08 ± 13.51% as indicated by (Barua and Chakraborty, 2011).

It is a toothy fish that causes (especially adult fish) painful bites for those who try to catch it (Robins et al, 1991) as in Figure (8). They are table fish of a high economic value in some countries (Ferreira et al, 1996), as in New Guinea (Correa, 2015). According to personal observations, the researcher has noticed that these fish are available Iraqi markets frozen from; their origin is Myanmar in 2016. However, it gradually began to decrease in quantities in Iraqi local market because of its taste which is not attractive to most consumers despite its cheap price, which does not exceed three US dollars. Now, it is available in limited quantities compared to its availability in the local market for the first time, noting that it was introduced to Iraq in 2000 as an ornamental fish. It was desired by amateurs for its peculiar shape, especially small sizes that do not exceed 10 cm in total length and

grow rapidly in ornamental aquariums, Pacu can reach a total length of 30cm in a record period.

Materials and Methods

Ethical Approval

All applicable national and international guidelines for the care and use of animals were followed.

Experimental Animal

The researcher collected 20 P. brachypomus fish as a study specimen from several shops in Baghdad. They were left to melt at room temperature. Then, some biometrics for the specimen were taken. The heads were cooked at the boiling point for only five minutes and placed in cold water immediately after cooking to stop the cooking process. They were soaked for 15 minutes in cold water; the tissues, muscles, Gills operculum, and the rest of the tissues and organs that were not included in the study were removed by forceps and a scalpel. The skulls, then, were washed well and softly with running water. The skulls were kept in a dilute formaldehyde solution at a concentration of 10% for one week only.

The bones were removed from the dilute formaldehyde solution 10%. The skulls were washed with clean running water for five minutes. Then, they were kept in a diluted ethyl alcohol solution at 70% for a week to get rid of fat and water remaining in the bones; then, they were left to dry at room temperature on blotting paper for another week to prepare them for x-ray and conducting the rest of the required biometrics. This method of preparing bones is followed according to Taylor and Dyke's 1985 method.

The Otolith was extracted using the method of (Milton and Chenery, 1998; Easey and Millner, 2008). The Otolith was preserved in alcohol at a concentration of 70% for a whole month. Then, it was left to dry on blotting paper at room temperature and were preserved in marked small plastic bottles. A Dino-lite digital microscope pro at magnification power (40X) in diagnosing the Otolith was used.

Results and Discussion

The average of the sample consisting of 20 fish was taken and studied. The results of the sample analysis at the rates are as shown in Table (1).

Table 1. Rates of studied traits of the study sample consisting of 20 specimens of P. brachypomus fish

Parameters	Means
Total length	29.25 cm
The standard length	26.55 cm
The distance from the front of the head to the eye	1.6 cm
The eye diameter	1.35 cm
Body width	12.5 cm
The width of the caudate peduncle	3.7 cm
The caudal peduncle length 4.5 cm	4.5 cm
Caudal fin length	3.3 cm
Anal fin length	1.6 cm
Dorsal fin length	1.55 cm
Pelvic fin length	2.95 cm
Pectoral fin length	4.5 cm
The fatty fin length	1.3 cm
Front head length	5.5 cm
Number of pectoral fin rays	10
The number of pelvic fin rays	7
The number of dorsal fin rays	16
The number of anal fin rays	27
Body thickness	5 cm
The number of caudal fin rays	24
Weight	632 gm
The number of front teeth of the lower jaw	8
The number of front teeth of the upper jaw	15
Head length	7.5 cm
The weight of the cranial bones	2.25 gm

The average length of the specimens in this study is 29.25cm and the average length of the study specimens is 26.55cm. The average standard length of the specimens in this study is within the limits of the standard-length rates of Pacu specimens collected from the Sibek River, which is close to the standard length of this species of fish from the Amazon River; it is 16-34cm as stated by (Correa, 2015). The average total length of the study specimens exceeded the specimens of Pacu fish collected from Lake Tarabato in Colombia; they are 11.5-17.5cm. The difference may be attributed to the seasons of fish collection, fishing, fish age, and size during the collection of samples; besides, there are differences among different regions in the

world. Figure (1) shows the Pacu fish I found in some of Baghdad's markets.

Figure 1. P. brachypomus found in some of Baghdad market

Reviewing the average length of the study specimen, it appears to be superior to the standard length of these fish, first recorded in Iran - Lake Zarivar whose standard length is 17.7cm as explained by (Hamid et al., 2017). The difference in the size of this study specimen maybe because they not from free-range or caught fish, but rather from the farmed fish that have recently been introduced into the breeding and improvement systems, as indicated by (Barua and Chakraborty, 2011). On the other hand, these fish weight is more than 1.25kg and the standard length is 29.7cm when fed with diets of correct proportions compatible with their nutritional needs when they are raised for a year in the breeding and culture ponds. The fish raised in farms outweigh the fish due to the proper care and feeding that follows the species (Sharma, 1997). The fish of this study surpass the weight of our study specimens; the average weight of the specimens is 632g and the average length is 26.5cm.

As far as the bones of the Pacu skull are concerned, we notice from Figure (2) a front view of the upper and lower jaws; we also notice from the picture some bone differences, especially in the lower jaw (Figure 3 on the right). There is an irregularity in the distribution of teeth rows, especially in the lower jaw Figure (2). We can also see the splitting of the lower jaw into two divergent pieces, Figure (3). These differences between the facial bones may be the result of some bone deformities that may give symmetry between the bones of the same face and between the facial bones or the bones of the body between the specimens collected for the same species. These distortions may be due to the influence of some different environmental factors in different growth stages of the fish; or that these deformations are of natural origin (Gavaia et al, 2009).

Figure 2. Facial bones of P. brachypomus anterior

Figure 3. P. brachypomus Lower jaw from above

Noting that the facial bones do not appear differentiated and different before preparing the bones, removing the flesh and connective tissues, as in Figure (4). The differences of the lower jaw side shape do not appear when the bones are being cleaned, Figure (5) Generally, the skeleton growth is affected; some bones are affected by external environmental factors that carry harmful environmental influences in fish larval and

adolescent stages of growth (Koumoundouros, 2010). Face and jaw bones may be affected in a clear and apparent way by bony deformities. Abnormalities give evidence of a poor fish environment in the early stages of life, as it happened in the mouth deformities of goldfish. The first case of the deformation was diagnosed as a dextral twisted mouth and Scoliosis (Jawad *et al.* 2020).

Figure 4. View of the upper and lower jaws of P. brachypomus

Figure 5. Lower jaw of P. brachypomus from the side

There are no differences or abnormalities between the upper jaw of the study specimens in size. The difference in jaw and face size of fish individual growth may follow the genes for growth. Age plays an important part in bones' size and shape, (Figure 6, 7).

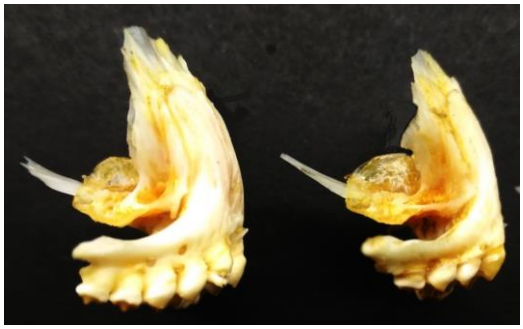

Figure 6. Upper side jaw of *P. brachypomus*

Figure 7. Upper jaw of P. brachypomus from below

The average weight of some skull bones of the specimens fish is 2.25g, which gives evidence of the heaviness of the bones of this species. Physiological and morphological studies have neither addressed the weight of the bones of the species nor compared their results to identify bones features and composition. Fish species certainly differs from one species to another, especially that bone tissue may differ from one species to another, depending on the genetic genes in the formation of the bones of that species. the environmental elements affecting development and the nature of body composition in water, as well as the type and nature of the food that provides different types of species with various elements that may be available for one species but missing for another. Besides, the effect of heavy elements in water and the extent of deposition of those elements in the bodies of the fish is a vital factor. Familiarity with the environment is vital for fish species, their feeding pattern, and the amount of metabolism as well; this is argued by (Jogeir et a., 2007) who showed that active fish with a low-fat content in the nature of their body composition have low levels of calcium and phosphorous concentrations. However, the less active fish species, with a high fatty buckle in their bodies, have high concentrations of these two elements, which gives weight to the bones of these species.

The otolith was diagnosed of the study specimen after it was extracted, and pictures were taken from the front and back sides of the bone shown in Figure (8). Otolith is an important evidence in modern anatomy that indicate different species of fish according to the shape of bones and thus to the family of that species of fish (Battaglia et al., 2010). By diagnosing the otolith, the species can be

accurately identified, (Campana, 2004) and (Campana and Casselman, 1993). The luster and shining of the otolith give an idea of the quality of the food which Pacu fish consumes and the mineral elements this food contains. Pacu is a fish of omnivorous feeding (Correa, 2015). Pacu stomach contains 65, 52% of aquatic plants remains represented by some leaves, roots, and seeds of monocots, and 62.07% of fish remains like fins, fin rays, and some fish guts, 13.79% of water insects like Diptera, invertebrates such as Decapoda accounted for 3.45% of the stomach content of these fish. The proportion of vertebrates represented by bones, teeth, and hair remains is 6.90%. Arthropod parts are 10.34%. The strength of this luster in the otolith can be explained by the feeding pattern according to the age and growth stage, as well as the availability of some mineral elements in food and the environment (Jobling et al, 2008)

Figure 8. *P. brachypomus* otolith

Conclusions

For those interested in the biological diversity in the Middle East, in which these fish have recently spread, it is possible to further studies and research be conducted, Including the biology of Pacu fish, and accurate manner, to study the different feeding patterns, the nature of bone formation in general. It is necessary to find out diagnostic and taxonomic indicators, especially among the species of the same family. As experts have observed (in the past few decades) that the major growth processes appear to be widely shared among vertebrates which are supported by studies concerned with microanatomy, gene evolution, molecular biology, and gene expression. Molecular biology and genetic studies have dealt only with a limited number of fish species; more research and investigation are still required.

Conflict of Interests

The author whose name is listed below certifies that he has no affiliations with or involvement in any organization or entity with any financial interest, or non-financial interest (such as personal or professional relationships, affiliations, knowledge, or beliefs) in the subject matter or materials discussed in this manuscript.

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